DOCUMENT RESUME

ED 028 982 SP 002 475

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The Effects of Individual Differences on Observational Learning in the Acquisition of a Teaching Skill.

Pub Date Feb 69

Note-21p.; Presented at the annual meeting of the American Educational Research Association, Los Angeles, California, February 1969

EDRS Price MF-$0.25 HC-$1.15

Descriptors-Films, *Individual Differences, *Learning, Perception, Teaching Models, Teaching Skills, *Training Techniques, Verbal Ability

A study examined the effects of verbal and perceptual aptitudes in relation to the efficacy of two different kinds of modeling procedures (written and filmed presentations) in the acquisition of a teaching skill (analytic questioning). It was anticipated that for Ss receiving the film-mediated model, criterion scores would show stronger relation to perceptual abilities, while for Ss receiving the written model, they would show stronger relation to verbal abilities. Following administration of aptitude tests, 121 Stanford teacher trainees were randomly assigned to three treatment groups: one using a filmed portrayal of analytic questioning; one, a written text from the film sound track; and another, a control treatment which included no model. All Ss received the initial instruction and microteaching pretest followed by two cycles of models, rehearsal, and microteaching. Classroom performance measures of the use of analytic questioning in three separate microteaching sessions were obtained by four raters who independently assessed typed transcripts of the sessions; two written posttests were also administered. Results of analysis of variance showed that both modeling treatments produced greater behavior change than the control treatment, and that film-mediated modeling was consistently more effective than written modeling. Results of regression analysis indicated that visual or verbal modes of instructional presentation may or may not be related to corresponding scores of perceptual or verbal aptitude tests. (JS)

THE EFFECTS OF INDIVIDUAL DIFFERENCES ON OBSERVATIONAL LEARNING IN THE ACQUISITION OF A TEACHING SKILL

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Paper Presented at the Meeting of the
American Educational Research Association

February 1969

THE EFFECTS OF INDIVIDUAL DIFFERENCES ON OBSERVATIONAL LEARNING IN THE ACQUISITION OF A TEACHING SKILL[1]

It has long been recognized that individual differences are of potential importance in understanding human learning. Yet individual differences have typically been disregarded by experimenters and learning theorists alike. However, recent developments (Gagné, 1967) indicate that individual differences and the interaction of these with treatment effects have become of both theoretical and experimental concern.

The position that learning effectiveness is a function of the interaction of both instructional treatments and learner characteristics has both theoretical and empirical support (Cronbach, 1957, 1967). Instructional methods differ. A review of the relevant research (Snow, Tiffin and Seibert, 1965; Blaine and Dunham, 1968; Grimes and Allinsmith, 1961) indicates that a person learns more easily from one method than another, that this best method differs from S to S and that such differences are related to learner characteristics.

One complex form of learning in which the role of learner characteristics might be studied is that of observational learning. The literature surrounding observational learning (Bandura and Walters, 1963; McDonald and Allen, 1967) suggests the educational significance of studying learning efficiency in association with modeling procedures. Research in this area has consistently shown that complex behavior may be acquired or modified through observation with no direct external reinforcement. While it has been suggested that observer characteristics influence the extent to which observational learning occurs (Bandura and Walters,

[1]This research was supported by a grant from the United States Office of Education, OE-8-1-073.

1963; McDonald and Allen, 1967), observer characteristics have been largely disregarded in previous research. Thus a study of the relationship between individual differences and the effectiveness of different modeling procedures, while exploratory, is important for evaluating factors influencing learning efficiency when modeling procedures are used in teacher training programs.

The purpose of this study was to examine the effects of verbal and perceptual dimensions of individual differences in relation to the efficacy of two different kinds of modeling procedures in the acquisition of a teaching skill. The two different methods of presentation employed in this study were written and film-mediated models. While both of these methods have been effective as training procedures (Bandura and Mischel, 1965; McDonald and Allen, 1967), differences between the two treatments have not been consistently significant. However, in view of the task differences generated by the two different modeling treatments, it seems reasonable to expect that different abilities may also be involved. Both modeling treatments were expected to produce greater behavior change than a control treatment. It was anticipated that for Ss receiving the film-mediated model, criterion scores should show stronger relation to perceptual abilities, while for Ss receiving the written model, criterion scores should show stronger relation to verbal abilities. These hypotheses imply that there are nonparallel regression slopes, and consequently, that one treatment will not be superior throughout the distributions of the perceptual and verbal ability variables. These predictions were derived from an analysis of task and ability variables corresponding to a theoretical model proposed by

Melton (1967) for investigating individual differences in learning. This model proposes a stimulus differentiation component, representing the Ss coding response to the physical stimulus; a response integration component, representing the output response; and a mediational component, representing the connection between the functional stimulus and the required response. Differences and similarities in task and ability variables involved in the two different modeling procedures may be represented in terms of this model. This representation is summarized in Table 1.

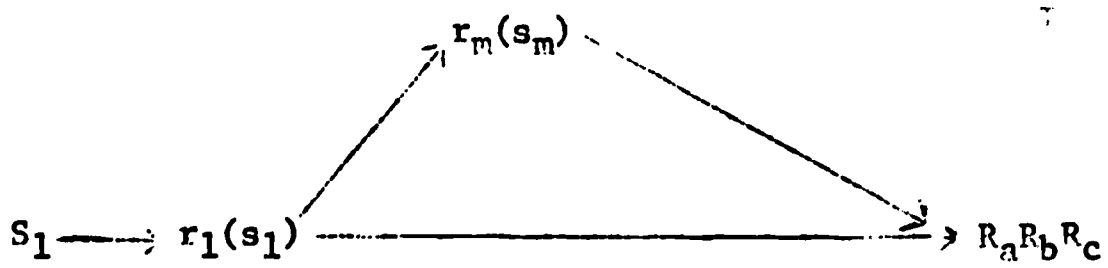
First, Ss in the Film-Mediated Modeling treatment view an actual portrayal of the teaching skill and of the pace of the lesson. This requires processing information from multiple channels simultaneously. Film-mediated models are extremely rich in perceptual detail with many different cues to which to attend. Many of these cues are extraneous to the relevant features of the model. These task characteristics would appear to require the ability to keep definite task-relevant dimensions in mind so as to make identification despite perceptual distraction. Moreover, Ss in the Film-Mediated treatment are expected to perceive and encode events as behavioral representation at the speed of presentation of the film. Consequently, they are able to review relevant material in memory only. These requirements appear to involve speed in perceptual evaluation and in exploring a complicated spatial field, as well as short term memory facility.

In the Written Modeling treatment, Ss read a written transcript of the sound track from the film-mediated model. Consequently, Ss in the Written treatment process information from a single channel in

TABLE 1

ORGANIZATION OF TASK AND ABILITY VARIABLES

IN A MULTI-PROCESS MODEL OF LEARNING



	Stimulus Differentiation	Association Mediation	Response Integration
Written Model	Read script of sound track	Generate associative context	Retain representation
	Set own reading pace	Transform verbal to behavioral representation	Generate new associates
	Reread, pause as needed		Integrate in behavioral context
	Code as verbal representation		
Film Mediated Model	View film, hear sound track	Generate associative context	Retain representations
	Keep pace with film	Transform behavioral to verbal representation	Generate new associates
	Review in memory		Integrate in behavioral context
Ability Variables	Flexibility of closure	Verbal Behavioral Transformation	Verbal memory
	Perceptual speed	Verbal Association	Audio-Visual memory
	Spatial scanning		Verbal fluency
	Short-term memory		
	Verbal comprehension		

	Stimulus Differentation	Association Mediation	Response Intergration
Aptitude Tests	Hidden Figures		Film Memory
	Identical Pictures		Memory for Ideas
	Maze Tracing		Sentence Repreduction
	Verbal Comprehension		Expressional Fluency
	Verbal GRE		

which they are able to establish their own pace and return to review relevant material as read. While Ss in the Written treatment must also distinguish the significant features of the model, the total set of stimuli to select from is limited to verbal components. These task variables would be expected to require the ability to comprehend written verbal material.

Corresponding to the mediational component of the model, it is hypothesized that Ss in both modeling conditions must generate their own analogy to the model's performance. While Ss in the Film-Mediated treatment are expected to abstract relevant verbal representation from behavioral representation, Ss in the Written treatment are expected to generate relevant behavioral representation from solely verbal components. These task variables would appear to require facility in both verbal association and in verbal-behavioral transformation.

Finally, corresponding to the response integration component of the model, it is expected that Ss in both treatments need to retain representations of their respective models, generate new examples of the skill being modeled, and integrate these examples into a behavioral context. These task variables would be expected to require both verbal fluency, and the ability to remember major ideas as well as details from audio-visual presentations for Ss in the Film-Mediated Modeling treatment, and verbal presentations in the case of Ss in the Written Modeling treatment.

Procedures

The selection of ability measures for use in this study was made

from the Kit of Reference Test for Cognitive Factors (French, Ekstrom and Price, 1963) and from a series of film and audio tests (Seibert and Snow, 1965; Seibert, Reid and Snow, 1967). The abilities assessed are believed to be those which distinguish most clearly between the two modeling conditions and are consistent with the analysis of task and ability variables derived from the model. For the purposes of this study, tests of perceptual ability include tests of figural cognition and audio-visual memory. Tests of verbal abilities refer to written tests of verbal cognition. Following the administration of verbal and perceptual aptitude tests, 121 Stanford intern teachers were randomly assigned to three treatment groups; a Film-Mediated Modeling treatment consisting of a filmed portrayal of Analytic Questioning, the particular teaching skill to be learned; a Written Modeling treatment consisting of a verbatim text from the sound track of the film-mediated model; and a Control treatment which received no model, but went through all other steps common to the two modeling treatments. Thus treatments were held constant in all ways except for the mode of model presentation. In terms of general procedures, all Ss received the initial instructions and microteaching pretest followed by two cycles comprised of models, rehearsal, and microteaching. Treatments were terminated with the completion of two written measures. These procedures are summarized in Table 2.

Consideration was given to several aspects of Analytic Questioning skill. Both classroom performance and written criterion measures were used in assessing treatment effects and ability performance relationships.

TABLE 2

TREATMENT PROCEDURES

Steps	Group			Time
	Film-Mediated Modeling	Written Modeling	Control	
1. Set Induction	X	X	X	5 min.
2. Teach 1 (Pretest)	X	X	X	10 min.
3. Model 1	Film Mediated	Written	Extraneous material	10 min.
4. Rehearsal 1	X	X	X	5 min.
5. Teach 2	X	X	X	10 min.
6. Model 2	Film Mediated	Written	Extraneous material	10 min.
7. Rehearsal 2	X	X	X	5 min.
8. Teach 3	X	X	X	10 min.
9. Test Administration	X	X	X	5 min.

Explanation of symbols: (X) indicates that all Ss received this step of the treatment in an identical manner. Written descriptions are provided for the two steps in which treatments varied among the three groups.

The classroom performance measures assessed included the frequency, variety and quality of Analytic Questioning used in three separate microteaching sessions. Typed transcripts of the teaching sessions were independently rated by four raters, with interrater agreement ranging between .81 and .97. The written measures consisted of a true-false test, in which Ss were asked to identify major categories of Analytic Questioning and a matching test in which Ss were asked to match questions according to membership in a particular category of Analytic Questioning.

Results

A 3 (Treatment Groups) x 3 (Teaching Sessions) repeated measures analysis of variance was used to test instructional treatment main effects for classroom performance measures. In the presence of significant interactions, tests on simple main effects were computed, in addition to direct tests on main effects (Winer, 1962). A one-way analysis of variance was computed between groups to determine if there were significant main effects for the written measures. In all cases, the Newman-Keuls procedure was used in comparisons of pairs of treatments following a significant overall F ratio.

The results obtained strongly support the hypothesis that both modeling treatments would produce greater behavior change than the Control treatment. Both Written and Film-Mediated Modeling treatments led to significantly higher frequency variety and quality of Analytic Questioning than did the Control treatment both for Teaching Sessions 2 and 3, while between group differences were not found for Session 1.

Similarly, Ss in the Written and Film-Mediated Modeling treatments performed significantly better on both written measures than did Control group Ss. Additional evidence of the effectiveness of the modeling treatments is provided by within group analyses of changes in Analytic Questioning behavior from base rate to subsequent teaching sessions. Both Film-Mediated and Written Modeling conditions produced significant increases in the frequency, variety and quality of Analytic Questioning, while the Control group did not display such increments. Moreover, from the average data alone, training under Film Mediated Modeling conditions appears to have been consistently more effective than training under Written Modeling conditions across all measures of the dependent variable. These results are summarized in Tables 3 through 6.

Aptitude x treatment interactions were evaluated by comparing regression slopes for different treatments using F tests for heterogeneity of regression. Although aptitude x treatment interactions were obtained, the direction of the interactions did not consistently correspond to predictions and was at times opposite to that hypothesized. Analyses of interactions indicated that scores on Film Memory interacted significantly with the presentation conditions for the quality of Analytic Questioning. Scores were positively related to performance in the Film-Mediated treatment, while unrelated to performance in the Written Modeling treatment. Thus Ss scoring high on Film Memory learned to use high quality Analytic Questions better from the Film-Mediated Modeling treatment; those scoring low learned better from the Written Modeling treatment. These results are consistent with initial predictions.

Table 3

Summary of Analyses of Variance

Criterion	Source of Variation	F
Analytic Questions	Treatment Groups	32.10**
Analytic Questions	Teaching Sessions	75.31**
Analytic Questions	Treatment x Sessions	29.41**
Categories of Analytic Questions	Treatment Groups	24.75**
Categories of Analytic Questions	Teaching Sessions	54.17**
Categories of Analytic Questions	Treatment x Sessions	27.65**
High Quality Analytic Questions	Treatment Groups	38.67**
High Quality Analytic Questions	Teaching Sessions	79.74**
High Quality Analytic Questions	Treatment x Sessions	32.61**
True-False Test	Treatment Groups	20.76**
Matching Test	Treatment Groups	32.94**

* $p < .05$
** $p < .01$

Table 4
Summary of Analyses of Variance
Simple Main Effects

Criterion	Source of Variation	df	MS	F
Analytic Questions	Between Groups			
	Teaching Session 1	2	.16	.01
	Teaching Session 2	2	1030.25	46.27**
	Teaching Session 3	2	1191.01	50.55**
	Error Between Groups	351	23.56	
	Within Groups			
	Film-Mediated	2	1335.51	30.13**
	Written	2	442.00	9.74**
	Control	2	6.30	.14
	Error Within Groups	234	13.18	
Categories of Analytic Questions	Between Groups			
	Teaching Session 1	2	1.34	.97
	Teaching Session 2	2	46.90	34.23**
	Teaching Session 3	2	66.05	48.21**
	Error Between Groups	351	1.37	
	Within Groups			
	Film-Mediated	2	75.65	86.95**
	Written	2	18.98	21.81**
	Control	2	1.84	2.11
	Error Within Groups	234	.87	
High Quality Analytic Questions	Between Groups			
	Teaching Session 1	2	.90	.08
	Teaching Session 2	2	652.46	51.37**
	Teaching Session 3	2	734.11	57.80**
	Error Between Groups	351	12.69	
	Within Groups			
	Film-Mediated	2	906.27	117.39**
	Written	2	225.52	29.25**
	Control	2	1.83	.32
	Error Within Groups	234	7.72	

* p <.05

** p <.01

Table 5
Tests on Means Using Newman-Keuls Procedure

Criterion	Teaching Session	Difference Between Pairs
Analytic Question		
FM[a] > C[c]	2	10.08**
WM[b] > C	2	4.84**
FM > WM	2	5.24**
FM > C	3	10.65**
WM > C	3	7.16**
FM > WM	3	3.49**
Categories of Analytic Questions		
FM > C	2	2.14**
WM > C	2	1.30**
FM > WM	2	.84**
FM > C	3	2.51**
WM > C	3	1.65**
FM > WM	3	.86**
High Quality Analytic Questions		
FM > C	2	7.98**
WM > C	2	3.26**
FM > WM	2	4.72**
FM > C	3	8.47**
WM > C	3	5.05**
FM > WM	3	3.42**
True-False Test		
FM > C		3.93**
WM > C		2.77**
FM > WM		1.16
Matching Test		
FM > C		3.68**
WM > C		2.74**
FM > WM		.94*

* $p < .05$

** $p < .01$

a Film Mediated Modeling Treatment
b Written Modeling Treatment
c Control Treatment

TABLE 6

MEANS AND STANDARD DEVIATIONS OF DEPENDENT VARIABLES

Performance Measure	Treatment Group					
	Film-Mediated Modeling		Written Modeling		Control	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Analytic Questions, T_1	3.61	3.37	3.62	3.30	3.72	3.10
Categories of Analytic Questions, T_1	1.43	1.12	1.75	1.01	1.76	1.11
High Quality Analytic Questions, T_1	1.88	2.02	1.75	1.89	2.18	2.24
Analytic Questions, T_2	13.40	6.41	8.16	5.59	3.31	2.50
Categories of Analytic Questions, T_2	3.73	1.10	2.89	1.39	1.59	1.05
High Quality Analytic Questions, T_2	9.90	5.20	5.17	3.84	1.92	1.70
Analytic Questions, T_3	13.58	6.33	10.09	7.11	2.93	3.25
Categories of Analytic Questions, T_3	3.85	1.17	2.98	1.37	1.33	.97
High Quality Analytic Questions, T_3	10.15	5.52	6.72	4.42	1.68	2.24
Matching Test	11.82	2.36	10.67	3.09	7.97	2.88
True-False Test	10.70	2.02	9.77	2.35	7.90	1.90

In contrast to these findings, however, scores on Hidden Figures produced significant disordinal interactions for the frequency, variety and quality of Analytic Questions. While Hidden Figures scores were positively related to performance in the Written Modeling treatment, they were negatively related to performance in the Film-Mediated Modeling treatment. Thus, high scoring Ss learned to use greater frequency, variety and quality of Analytic Questions from the Written treatment, while those scoring low profited more from the Film-Mediated treatment. Similarly, with respect to performance on the written measures, scores on Film Memory and Maze Tracing interacted significantly with presentation conditions. This time, the regression slope obtained for the Written Modeling treatment was positive, while Film Memory scores were negatively related to performance in the Film-Mediated treatment. Scores for Maze tracing were positively related to performance in the Written Modeling treatment while unrelated to performance in the Film-Mediated treatment. These results show that Ss with high scores on Film Memory and Maze Tracing performed better on the written measures under the Written Modeling treatment, whereas low ability Ss benefited more from the Film-Mediated treatment. These results are summarized in Table 7.

Discussion

It will be recalled that the major purpose of this experiment was to examine the effects of trainee aptitude on observational learning. While aptitude x treatment interactions were obtained, the direction of the interactions was not consistent to that hypothesized.

Table 7
Summary of Simple Regression Analyses
Significant Disordinal Interactions

Criterion	Teaching Session	Predictor	Treatment Groups: Film-Mediated a	Film-Mediated b	Written a	Written b	Control a	Control b	F
Analytic Questions	2	Hidden Figures	14.90	-.24	4.19	.61**	3.34	.02	4.02*
Analytic Questions	3	Hidden Figures	16.08	-.39*	3.87	.96**	2.71	.05	8.25**
Categories of Analytic Questions	2	Hidden Figures	4.11	-.06	2.14	.12*	1.76	.04	3.28*
Categories of Analytic Questions	3	Hidden Figures	4.76	-.14**	2.08	.14**	1.30	.01	8.88**
High Quality Analytic Questions	2	Hidden Figures	11.54	-.25*	2.57	.40*	1.63	.04	4.20*
High Quality Analytic Questions	3	Hidden Figures	11.89	-.27*	3.01	.57**	1.88	-.03	5.70**
High Quality Analytic Questions	3	Film Memory	-2.38	.62**	7.16	-.02	-.85	.13	4.42*
True-False Test		Film Memory	13.09	-.11	6.32	.17*	3.65	.17*	4.01*
True-False Test		Maze Tracing	10.74	.00	5.91	.27**	8.58	-.10	4.94**
Matching Test		Maze Tracing	12.95	-.08	3.77	.47**	9.09	-.07	7.44**

* $p < .05$
** $p < .01$

Note: a and b are of the form $\tilde{Y} = a + bx$

The initial hypotheses regarding the direction of aptitude x treatment interactions were based upon an analysis of task and ability variables corresponding to the theoretical model presented in Table 1. Accordingly, it is suggested that trends observed in the present data might conceivably be interpreted within the framework of that model. The results obtained indicate that visual or verbal modes of instructional presentation may or may not be related to corresponding scores on perceptual or verbal aptitude tests. While it would seem that an audio-visual mode of presentation would constitute a demand on perceptual encoding systems, the audio-visual presentation could also conceivably serve a compensatory function through the provision of perceptual information that might otherwise be demanded of the S. Similarly, the lack of audio-visual content in an instructional presentation may require Ss to generate their own perceptual detail, thus constituting a demand on the perceptual encoding system.

An inspection of the direction of the aptitude x treatment interactions obtained suggests that those abilities involved in the stimulus differentiation component of the model might generally serve the compensatory function described above. Conversely, based upon supplemental data as well as the data described here, the relationship of test to task in the response integration component of the model appears direct rather than compensatory, with scores on tests of audio-visual memory related to performance in an audio-visual mode of presentation, while unrelated to performance in a written mode of presentation. Sufficient evidence was unavailable concerning the direction of aptitude x treatment interactions in the mediational component of the model.

While the evidence on this matter is not overwhelming, and may be variously interpreted, the model would appear to be useful, at least in a heuristic sense.

Implications Although it has not been demonstrated that the training procedures utilized in this investigation represent the most effective way to train teachers, these findings provide evidence that through observation, trainees can acquire principles exemplified in a model's behavior and use them for generating novel combinations of teaching behavior. Accordingly, this research suggests that the use of written and film-mediated modeling procedures is a highly effective means of modifying teaching behavior in training contexts analagous to those described in this experiment. Moreover, while questions concerning interactions between specific teaching skills and instructional conditions have yet to be resolved, there is further evidence, from the average data alone, to recommend the use of film-mediated modeling procedures over written modeling procedures.

This research does not lead to detailed suggestions for specific modifications and developments regarding the individualization of teacher training programs. Experiments such as these have only begun to explore the wide range of problems concerned with finding effective teaching techniques for students with different characteristics. However, there are both cost and efficiency implications for teacher training in these results. Given replication of these findings, assignment of trainees to alternating treatments is appropriate for maximizing learning. Moreover, the cost of training is reduced considerably as more teachers can be

assigned to written rather than film-mediated treatments. Continuing research in this area may eventually provide a basis for the individualization of teacher training programs.

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